INDOOR AIR QUALITY ASSESSMENT

Lincoln Park Community School
290 Washington Street
Somerville, MA 02143

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
June 2005

Background/Introduction

At the request of Bob Ciampi, former Facilities Director, Somerville Public Schools (SPS), the Massachusetts Department of Public Health's (MDPH) Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality concerns at the Lincoln Park Community School (LPCS), Somerville, Massachusetts. The request was prompted by concerns related to water damage. On June 16, 2004, a visit to conduct an indoor air quality assessment was made to the PHCS by Sharon Lee and Cory Holmes, Environmental Analysts in MDPH's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Miss Lee returned on May 5, 2005 to conduct an additional assessment of the building exterior.

The LPCS is a three-story cement building constructed circa 1975. The first floor consists of general classrooms, offices, kitchen, cafeteria, library, and gymnasium. The second and third floors primarily consist of classrooms arranged in pod formations, with three pods on each floor.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). MDPH staff performed a visual inspection of building materials for water damage and/or microbial growth. Moisture content of carpeting and materials prone to moistening was measured with a Delmhorst, BD-2000 Model, Moisture Detector equipped with a Delmhorst Standard Probe.

Results

The school houses approximately 540 students in pre-kindergarten through eighth grade and a staff of approximately 110. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in 3 of 47 areas surveyed, indicating adequate ventilation in the majority of areas surveyed in the building. It is important to note that several areas were empty or sparsely populated and/or had open windows at the time of assessment. Low occupancy and open windows can greatly reduce carbon dioxide levels.

Mechanical ventilation is provided by rooftop air handling units (AHUs) (Picture 1). Fresh air is distributed to classrooms via ductwork connected to vents or slotted air diffusers located between ceiling tiles (Pictures 2 to 4). Return air is drawn into ceiling vents and exhausted out of the building via an exhaust fan (Picture 5). The AHU for the gymnasium was set to 'winter' (Picture 6). As a result, this AHU was either operating weakly or off at the time of assessment. Additionally, the exhaust systems for the gymnasium and some restrooms were deactivated at the time of the assessment. Moreover, some rooms did not have mechanical exhaust vents. Consideration should be given to undercutting doors for these rooms as a means of exhausting air into hallways. Without exhaust capabilities or with the existing systems not operating as designed, normally occurring pollutants cannot be removed.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room, while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years (SMACNA, 1994). The date of the last balancing was not available at the time of the assessment.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please consult Appendix A.

Temperature measurements ranged from 71^{o} F to 81^{o} F, which were above the MDPH comfort guidelines in some areas. The MDPH recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measurements in the building ranged from 40 to 56 percent, which were within the MDPH recommended comfort range. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

According to SPS staff, the LPCS has a history of water intrusion problems. When raining, water is often noted to be penetrating the library via an exterior door (Picture 7). During periods of rain, water appears to cascade down a cement wall adjacent to this access way (Picture 7), as demonstrated by the presence of efflorescence (Picture 8). Efflorescence is a characteristic sign of water damage to building materials, but it is not mold growth. As moisture penetrates and works its way through the exterior wall, water-soluble compounds dissolve, creating a solution. As the solution moves to the surface of the interior wall, water evaporates, leaving behind white, powdery mineral deposits.

Water penetrating through the library door, the roof and the wall has also damaged carpeting around the staircase. To ascertain the extent of water damage, MDPH staff took moisture readings of carpeting in the library in both affected and unaffected areas. Moisture content was measured with a Delmhorst Moisture Detector equipped with a Delmhorst Standard Probe. The Delmhorst probe is equipped with three lights that function as visual aids that indicate moisture level. Readings that activate the green light indicate a sufficiently dry or low moisture level, those that activate the yellow light indicate borderline conditions and those that activate the red light indicate elevated moisture content. Moderate moisture levels were measured in the carpeting at the corner of the library near the staircase. To prevent further damage to carpeting in the area, MDPH staff recommended removing the carpet near the door way and the staircase.

At the time of the assessment, MDPH staff observed water running down into the storage/girls locker room area from a damaged window (Picture 9). Water was observed to be pooling on the floor of this below grade area. It appears that the space directly outside of the damaged window is overgrown with plants. As a result, water is being drawn in by the plant roots and held against the building. Lack of drainage and the growth of plants have likely resulted in the drainage of water *towards* the building and subsequently through the building foundation. Water penetration and pooling in this area has resulted in water damage to building materials (i.e., floor, ceiling plaster).

Efflorescence was also noted on walls and support beams in a number of staircases throughout the building, as well as around windows in a number of hallways and classrooms (Pictures 10 to 12). A trash barrel was observed beneath a reported leak in the second floor hallway near staircase B (Picture 13). As discussed, efflorescence is an indication that water is penetrating the building.

Some areas also had water-damaged ceiling plaster and tiles, which can indicate leaks from the roof or plumbing system (Pictures 3 and 14). Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired. Water damaged porous materials were also noted in some areas (Picture 15). Like ceiling tiles, water damaged porous materials can provide a source for mold growth. These materials should be discarded to prevent such growth.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

MDPH staff examined the roof. Pooling water was seen in some areas, indicating inadequate draining (Picture 16). Cracks and breaches were also noted in the rubber membrane. As a result of water and debris accumulation, moss growth was noted on the roof surface (Picture 17). Repairing the roof and improving surface drainage is necessary to prevent further water penetration.

Damage to the exterior walls of the building was also noted (Picture 18). Missing brickwork, seams and breaches in and around brickwork were observed (Picture 19). Breaches were also noted around doors and windows. Holes, breaches, and seams are points through which water can penetrate the building, particularly under driving rain conditions.

Significant damage was noted to an overhang above a doorway to the shipping/receiving area (Picture 20). According to occupants, the overhang was damaged when a truck backed into the building. The truck caused damage to both the roof structure and the exterior wall (Picture 21). Because of the location of the damage, water penetration is a significant problem resulting in damage to adjacent classrooms.

Plants were observed growing against the foundation walls. Extensive plant growth was noted on the building exterior facing the train tracks (Picture 22). The growth of roots against exterior walls can bring moisture in contact with the foundation. Plant roots can eventually penetrate, leading to cracks and/or fissures in the sublevel foundation. Over time, this process can undermine the integrity of the building envelope, providing a means of water entry into the building via capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001).

Plants were also observed in several classrooms (Picture 23). Plants, soil and drip pans can serve as sources of mold growth, thus should be properly maintained. Over-watering of plants should be avoided and drip pans should be inspected periodically for mold growth. Plants should also be located away from ventilation sources to prevent aerosolization of dirt, pollen or mold.

Open seams between the sink countertop and wall were observed in several rooms. If not watertight, moisture can penetrate through the seam, causing water damage. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell and show signs of water damage. Moistened materials that are not dried within 24 to 48 hours can become potential sources for mold growth.

Other Concerns

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, MDPH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Outdoor carbon monoxide concentrations were non-detect or ND (Table 1). Carbon monoxide levels measured in the school were also ND.

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 microgram per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2000a). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent, PM2.5 standard requires outdoor air particle levels be maintained below 65 $\mu g/m^3$ over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

On the day of assessment, outdoor PM2.5 concentrations were measured at 21 $\mu g/m^3$ (Table 1). PM2.5 levels measured in the school were between 9-52 $\mu g/m^3$, which were above background in some areas (Table 1). Frequently, indoor air levels of particulates can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulates during normal operation. Sources of indoor airborne particulate may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices, operating an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air quality can also be negatively influenced by the presence of materials containing volatile organic compounds (VOCs). VOCs are carbon containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. An outdoor air sample was taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC concentrations were also ND.

In an effort to identify materials that can potentially increase indoor TVOC concentrations, MDPH staff examined classrooms for products containing these respiratory irritants. Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use of TVOC containing products. While no TVOC levels measured exceeded background levels, materials containing VOCs were present in the school.

Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Cleaning products were found on countertops and in unlocked cabinets beneath sinks in some classrooms (Picture 24). Like dry erase materials, cleaning products contain VOCs and other chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Also of concern are unlabelled bottles and containers. Products should be kept in their original containers and be clearly labeled for identification purposes, especially in the event of an emergency.

Several other conditions that can affect indoor air quality were noted during the assessment. MDPH staff noted severe damage to insulation around ducts for rooftop AHUs (Picture 25). Damaged insulation should be removed and replaced to ensure appropriate and proper functioning of the AHUs. Without proper insulation, the AHUs may not be able to provide the appropriate tempered air.

Deteriorating materials were also noted on the roof, in close proximity to the fresh air intake of the AHU (Picture 26). These materials should be removed to prevent further damage to the roof and to eliminate any possible source of odor that could be entrained into the roof top AHU. Entrainment of such materials may result in distribution of materials to the interior school environment.

Also of note was the amount of materials stored inside classrooms. In classrooms throughout the school, items were seen on windowsills, tabletops, counters, bookcases and desks. The amount of items stored in classrooms provides a means for dusts, dirt and other potential respiratory irritants to accumulate. Many of the items, (e.g. papers, folders, boxes) make it difficult for custodial staff to clean. The age of stored materials should also be considered. A large collection of older periodicals and other art supplies were noted in the art room.

Dust was noted to have accumulated on many surfaces. A number of supply and exhaust vents in classrooms were also noted with accumulated dust (Pictures 27 and 28). Air from supply vents can aerosolize dust accumulated on the vents. If exhaust vents are not functioning, back-drafting can re-aerosolize accumulated dust particles. Dust can be irritating to the eyes, nose and respiratory tract. Missing and ajar ceiling tiles were observed in several areas. Missing ceiling tiles can serve as pathways for dust, dirt, odors and other pollutants to move into occupied areas. Tiles should be replaced to prevent movement of particles.

In an effort to reduce noise from sliding chairs, tennis balls had been spliced open and placed on chair legs (Picture 29). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix B (NIOSH, 1998).

Staff indicated concerns regarding the carpets. Most carpeting in the building is original and, in many of the rooms, stained. Currently, the carpet is cleaned with a standard vacuum cleaner. To control for dusts and particles, daily use of a vacuum equipped with a high efficiency particulate arrestance (HEPA) filter is recommended.

Lastly, food is an attractant to pests and rodents (e.g., food stored in open areas). Proper food storage is an integral component in maintaining indoor air quality. Food should be properly stored and clearly labeled. Reuse of food containers (e.g. for art projects) is not recommended since food residue adhering to the container surface may also serve to attract pests.

Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Seal all holes and breaches along the exterior walls and around windows and doors.
2. Contact a roofing contractor or building envelope specialist to determine the most appropriate method to repair the roof and prevent water leaks.
3. Remove carpeting around the exterior door and stairway of the library. Seal edges of the remaining carpet to prevent tripping.
4. Ensure all water damaged materials are removed and discarded.
5. Consult *Mold Remediation in Schools and Commercial Buildings* published by the US EPA (2001) for more information on mold. Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.
6. Remove plant growths against the exterior wall/foundation of the building.
7. Operate both supply and exhaust ventilation continuously, independent of classroom thermostat control, during periods of school occupancy to maximize air exchange.
8. Install passive door vents or undercut doors by at least one inch to provide a source of transfer air to rooms lacking a natural or mechanical fresh air supply.
9. Consider adopting a balancing schedule for mechanical ventilation systems every 5 years, as recommended by ventilation industrial standards (SMACNA, 1994).
10. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted

to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (e.g., throat and sinus irritations).

11. Seal breaches, seams, and spaces between sink countertop and backsplash to prevent water damage.
12. Ensure plants have drip pans. Avoid over watering and examine drip pans periodically for mold growth. Disinfect with an appropriate antimicrobial where necessary.
13. Remove and replace damaged AHU insulation.
14. Remove aged and damaged materials from the roof.
15. Clean dry erase board trays and pencil sharpeners regularly to avoid build-up of particulates.
16. Store cleaning products properly and out of reach of students. Ensure spray bottles are properly labeled.
17. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
18. Clean supply, exhaust and return vents periodically to prevent excessive dust build-up.
19. Consider discontinuing the use of tennis balls on chair legs.

20. Store and label food appropriately. Refrain from re-using food containers. Use the principles of integrated pest management (IPM) to rid the building of pest.
    A copy of the IPM Guide can be obtained at the following Internet address: http://www.state.ma.us/dfa/pesticides/publications/IPM_kit_for_bldg_mgrs.pdf

21. Consider adopting the US EPA (2000b) document, *Tools for Schools*, in order to provide self assessment and maintain a good indoor air quality environment. The document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

22. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://www.state.ma.us/dph/beha/iaq/iaqhoFtme.htm.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ASHRAE. 1989. ASHRAE Standard: Ventilation for Acceptable Indoor Air Quality. Sections 5.11, 5.12. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL.

Lstiburek, J. & Brennan, T. 2001. Read This Before You Design, Build or Renovate. Building Science Corporation, Westford, MA. U.S. Department of Housing and Urban Development, Region I, Boston, MA

MDPH. 1997. Requirements to Maintain Air Quality in Indoor Skating Rinks (State Sanitary Code, Chapter XI). 105 CMR 675.000. Massachusetts Department of Public Health, Boston, MA.

NIOSH. 1997. NIOSH Alert Preventing Allergic Reactions to Natural Rubber latex in the Workplace. National Institute for Occupational Safety and Health, Atlanta, GA.

NIOSH. 1998. Latex Allergy A Prevention. National Institute for Occupational Safety and Health, Atlanta, GA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBAA. 2001. Latex In the Home And Community Updated Spring 2001. Spina Bifida Association of America, Washington, DC.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning

US EPA. 2000a. National Ambient Air Quality Standards (NAAQS). . US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC. http://www.epa.gov/air/criteria.html.

US EPA. 2000b. Tools for Schools. Office of Air and Radiation, Office of Radiation and Indoor Air, Indoor Environments Division (6609J). EPA 402-K-95-001, Second Edition. http://www.epa.gov/iaq/schools/tools4s2.html

US EPA. 2001. "Mold Remediation in Schools and Commercial Buildings". Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001. Available at: http://www.epa.gov/iaq/molds/mold_remediation.html

Picture 1

Rooftop AHU handling unit

Picture 2

Ducted air supply vents

Picture 3

Ceiling supply vent

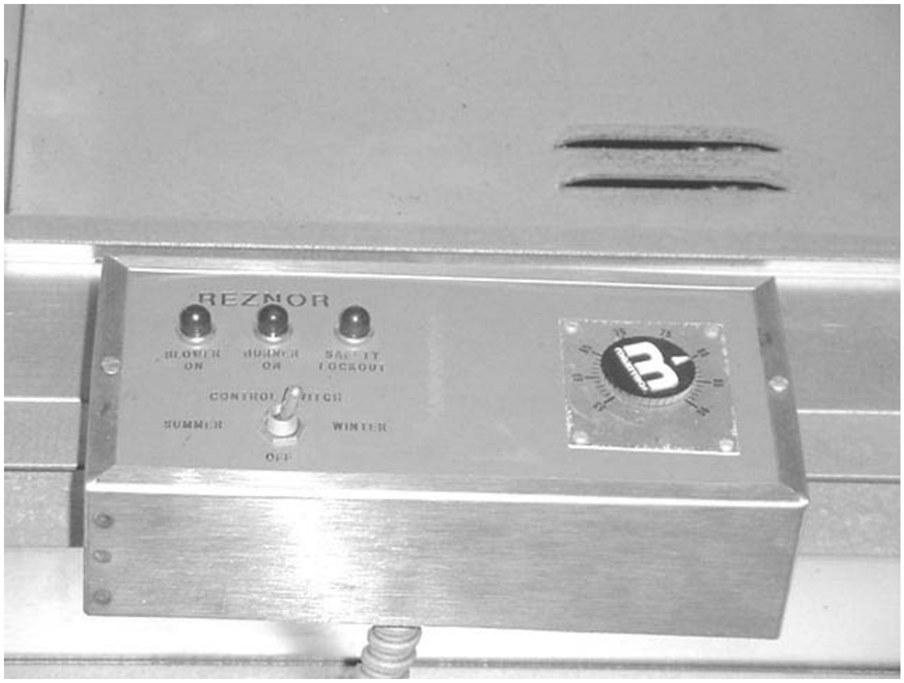
Picture 4

Slotted fresh air diffuser

Picture 5

Rooftop exhaust fan

Picture 6



Gym AHU set to 'winter'

Picture 7

Library area with water damage

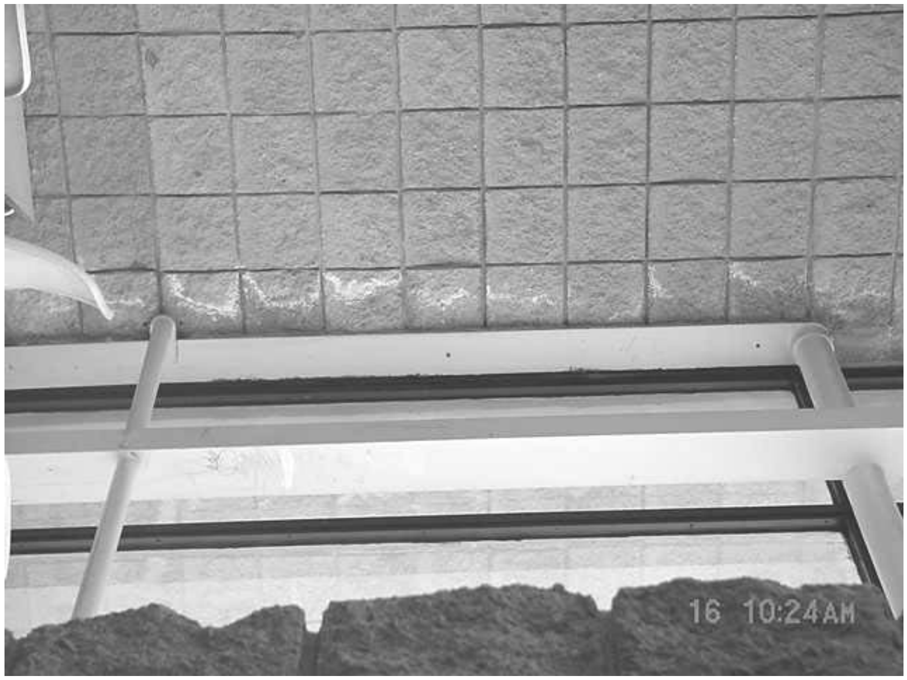
Picture 8

Efflorescence on wall in library

Picture 9

Window area through which water penetrates the storage/girls locker room area

Picture 10



Efflorescence on ceiling above hallway window

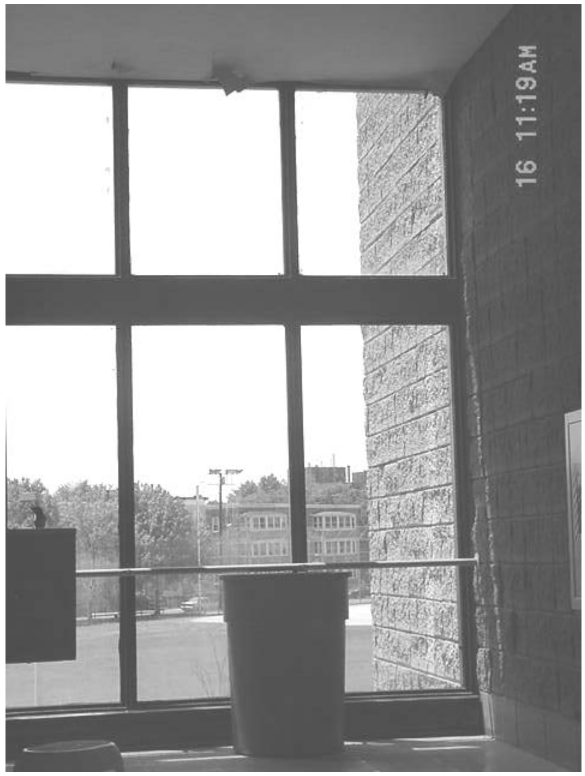
Picture 11

Efflorescence in stairway

Picture 12

Efflorescence in stairway

Picture 13



Trash barrel for collecting water from leak

Picture 14

Water damaged ceiling tiles

Picture 15

Water damaged corrugated cardboard box

Picture 16

Pooling water on roof

Picture 17

Moss growth on roof

Picture 18

Hole in exterior wall

Picture 19

Damage to window system and building

Picture 20

Overhang above shipment receiving bay

Picture 21

Damage to exterior wall and roof structure

Picture 22

Plant growth against building on exterior side facing train tracks

Picture 23

Plants in classroom

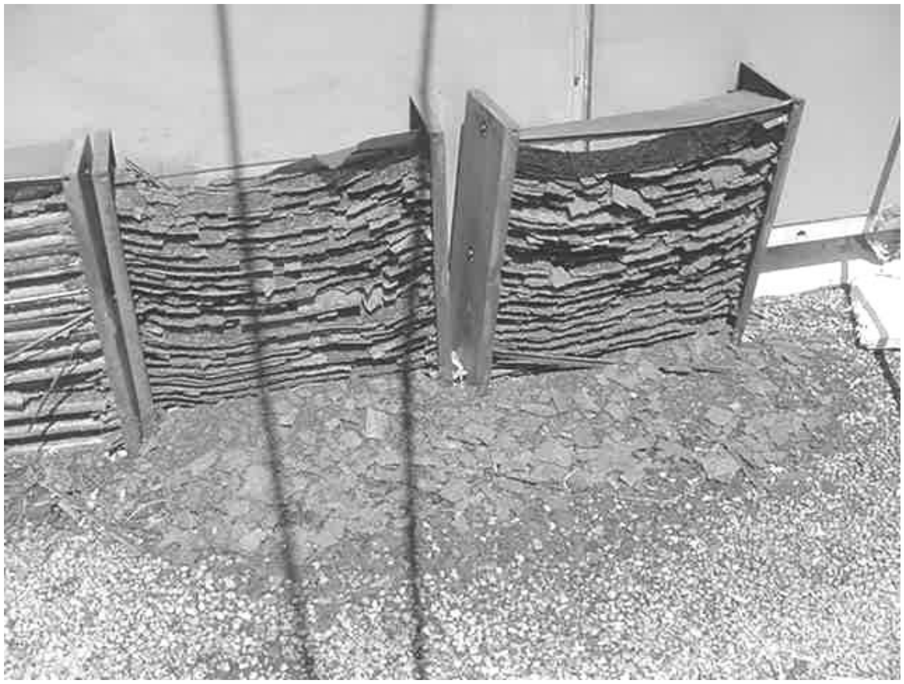
Picture 24

Cleaning products on sink counter

Picture 25

Damaged AHU insulation

Picture 26

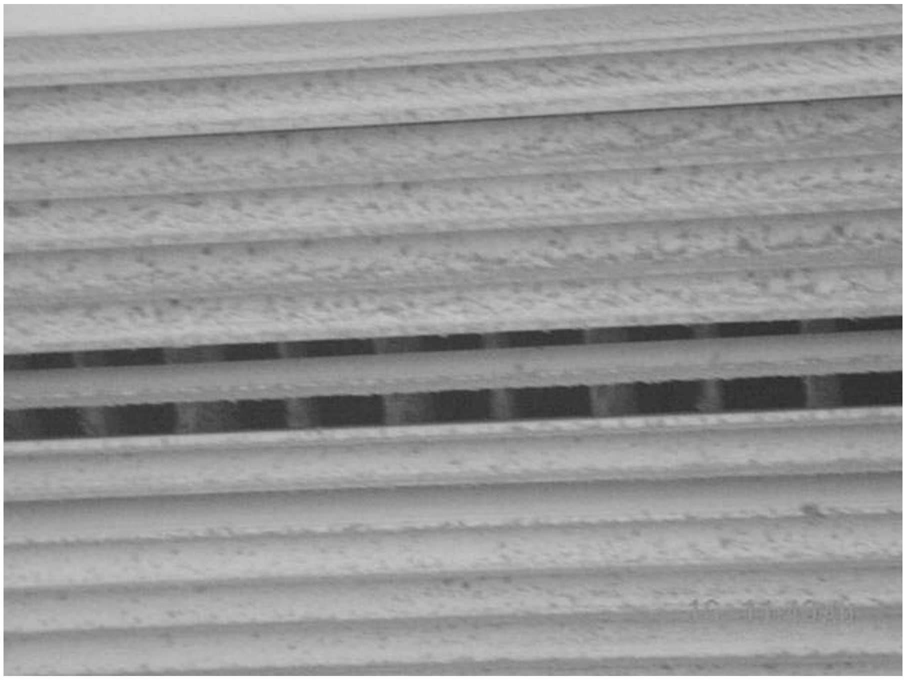


Damaged and aged materials on roof

Picture 27

Supply vent with accumulated dust

Picture 28



Exhaust vent with accumulated dust

Picture 29

Tennis balls in chair legs

Lincoln Park Community School | **Indoor Air Results**
290 Washington St, Somerville, MA 02143 | **June 16, 2004**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
background		85	47	432	ND	ND	21	N			Comments: sunny, light breeze.
1M-10	1	72	53	521	ND	ND	12	N	Y ceiling	N	Inter-room DO, laminator, wet toner copier.
1M-14	0	72	50	492	ND	ND	13	N	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, #MT/AT : 4.
1M-15	0	71	52	527	ND	ND	12	N	Y ceiling	N	Inter-room DO
1M-16	1	71	54	557	ND	ND	16	N	Y ceiling	N	Inter-room DO, #WD-CT : 3.
1M-3	1	72	55	545	ND	ND	15	N	Y ceiling	N	Inter-room DO
1M-6	2	72	54	578	ND	ND	14	N	Y ceiling	N	Inter-room DO
1M-9	1	72	54	691	ND	ND	12	N	Y ceiling	N	Inter-room DO

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
WD = water damage
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

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Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
1S-1	0	75	42	553	ND	ND	16	N	Y ceiling	Y ceiling	Comments: wall-mounted AC; 2 broken windows.
1S-14	20	71	44	770	ND	ND	16	N	Y ceiling Occluded: dust/debris	Y ceiling Occluded: dust/debris	DEM, PF, TB, cleaners, Comments: no draw from restroom exhaust vent.
1S-18	21	71	48	880	ND	ND	19	N	Y ceiling	Y ceiling	Hallway DO, DEM.
1S-6	1	72	42	686	ND	ND	15	N	Y ceiling	Y ceiling	Hallway DO, DEM, cleaners.
1S-9	0	71	43	691	ND	ND	14	N	Y ceiling	Y ceiling	Hallway DO
2A-11	16	75	45	711	ND	ND	13	N	Y ceiling	Y ceiling	Hallway DO
2A-9	12	76	44	725	ND	ND	15	N	Y ceiling	Y ceiling	Hallway DO

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Lincoln Park Community School
290 Washington St, Somerville, MA 02143

Table 1

Indoor Air Results
June 16, 2004

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (μg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
2B-11	0	79	44	591	ND	ND	17	N	Y ceiling	Y ceiling	Hallway DO
2B-7	1	79	45	626	ND	ND	16	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Hallway DO, Comments: 19 occupants left 10 min prior to assessment.
2B-9	14	78	48	703	ND	ND	18	N	Y ceiling	Y ceiling	DEM.
2C-11	18	75	52	589	ND	ND	17	N	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, CD, PF, cleaners, items.
2C-7	15	77	48	548	ND	ND	18	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, breach sink/counter, CD, cleaners, items, food use/storage, items hanging from CT.

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									Supply	Exhaust	
2C-8	0	78	46	603	ND	ND	15	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, CD, cleaners, items, food use/storage.
2C-9	1	79	46	632	ND	ND	14	N	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, CD, cleaners, items hanging from CT.
2m-2 Computer Lab	14	73	48	655	ND	ND	9	N			#MT/AT: 14, Comments: 24 computers.
2S-4	0	72	43	547	ND	ND	14	N	Y ceiling	Y ceiling	Hallway DO, CD, TB, cleaners, items hanging from CT.
2S-7	0	75	40	520	ND	ND	11	N	Y ceiling	Y ceiling	Hallway DO, CD, cleaners, food use/storage, items hanging from CT.

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									Supply	Exhaust	
3A-11	14	76	46	770	ND	ND	16	N	Y ceiling	Y ceiling	Hallway DO, DEM.
3A-7	19	76	46	763	ND	ND	14	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Dehumidifier.
3A-8	15	77	46	650	ND	ND	15	Y # open: 0 # total: 0	Y ceiling	Y ceiling	
3A-9	7	76	46	689	ND	ND	13	N	Y ceiling	Y ceiling	Hallway DO, DEM.
3B-10	0	81	46	479	ND	ND	16	N	Y ceiling	N	Hallway DO
3B-11	17	78	55	729	ND	ND	52	N	Y ceiling	Y ceiling	Hallway DO, CD, PF, items.

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									Supply	Exhaust	
3B-7	6	76	48	492	ND	ND	25	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, bubbler on carpet, CD.
3B-8	15	81	46	487	ND	ND	25	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, #WD-CT : 3, breach sink/counter, #MT/AT : 1, CD, items hanging from CT.
3B-9	15	80	51	894	ND	ND	16	N	Y ceiling	Y ceiling Occluded: dust/debris	Hallway DO, DEM, Comments: reports of poor airflow.
3C pod kitchen	0	74	45	617	ND	ND	12	N	Y ceiling	Y ceiling	Inter-room DO, Comments: WD-boxes.
3C-11	0	75	44	631	ND	ND	17	N	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, breach sink/counter, CD, Comments: WD-box.

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									Supply	Exhaust	
3C-7	0	73	42	615	ND	ND	15	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Inter-room DO, DEM, Comments: WD-wall.
3C-8	33	73	46	957	ND	ND	16	Y # open: 0 # total: 2	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, breach sink/counter, CD.
3C-9	6	74	46	679	ND	ND	46	N	Y ceiling	Y ceiling	Hallway DO, breach sink/counter, CD, DEM, cleaners.
3M-2	5	78	47	678	ND	ND	11	N	Y ceiling	Y ceiling	Inter-room DO, items hanging from CT.
3M-5	2	78	46	611	ND	ND	9	N	Y ceiling	Y ceiling	Inter-room DO, DEM, plants, Comments: water penetration around window frames.
3M-9	0	78	42	574	ND	ND	12	N			Plants.

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									Supply	Exhaust	
C32	0	77	41	533	ND	ND	12	N	Y ceiling	Y ceiling	Hallway DO, breach sink/counter, CD, PC, items hanging from CT.
C33	0	75	43	552	ND	ND	12	N	Y ceiling	Y ceiling	Hallway DO, Inter-room DO, #WD-CT: 3, CD, DEM, cleaners.
cafeteria	4	76	47	725	ND	ND	20	N	Y ceiling	Y ceiling	Hallway D
exit 10 near C-pod											Comments: reports of standing water and active leaks.
Faculty restroom across from 2A-9	0	78	48					N	N	Y wall (off)	

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									Supply	Exhaust	
gym	0	75	56	521	ND	ND	26	N	Y ceiling	Y wall (off) Occluded: dust/debris	Hallway DO, Comments: WD boxes; ceiling fan on.
library	0	77	46	582	ND	ND	11	N	Y ceiling	Y ceiling	WD-carpet, Comments: moderate moisture reading by stairwell (WD-carpet); low moisture reading in non-WD areas.
main office	1	72	53	547	ND	ND	12	N	Y ceiling	N	Hallway DO, #MT/AT: 2, PC, wet toner copier.
second floor hallway near staircase B											WD-ceiling, Comments: trash barrel catching water.

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